SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, SEPTEMBER 11, 1908

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y., or during the present summer to Wood's Hole, Mass.

SOME PROBLEMS OF THE INDUSTRIAL CHEMIST[1]

THIS address or talk is the outcome of a conversation with Professor Dennis a couple of months ago. After a rather prolonged discussion of many phases of industrial chemistry of mutual interest to both of us, he very kindly suggested that you as students and workers in chemistry might be glad to hear some of these same problems discussed in the same way. I am particularly happy to undertake this task because for six years I was a part of the university here and looked at chemical problems from what I may collectively call the university point of view, while for the last nearly four years I have been engaged in looking at these problems mainly from their commercial side. Due to a combination of circumstances, it was necessary for me to assume responsibility in manufacturing chemicals along lines I had never anticipated, and to come into intimate contact with every phase of the history of these chemicals, including their sale. A further combination of circumstances has put me into intimate touch with many industries not primarily chemical, but, being users of chemicals, they have troubles and call for assistance.

When you leave the university you will, as I have, of course, many times be forced to assume the responsibility of making decisions and giving some kind of a sensible judgment based on inaccurate knowledge

[1] Address given before the Cornell Section of the American Chemical Society, February 27, 1908.

or insufficient data. Many times you will fervently wish that you had become more thoroughly familiar with the characteristics of this or that chemical, or with standard practise in machine design, factory construction, the iron and steel industry, boiler construction, engines and a thousand and one things that could not possibly all be crowded into a college course of reasonable length. I have had under my direction or in my employ or associated with me quite a large number of engineers, chemical engineers, engineering chemists, industrial chemists, industrial engineers, draftsmen, chemical experts, manufacturing chemists and just plain chemists, besides one or two of those chemists who would have graduated in June only their eyes gave out about the first of February. These men have been graduates of European universities, including Berlin, Luxembourg and Upsala; American universities, including Cornell, Harvard, Princeton, Syracuse, Lafayette, Vermont and Massachusetts Institute of Technology and the Rensselaer Polytechnic; others of the men, among them some of the most efficient in chemical manufacture, have had no university training whatever, but have entered chemical works as boys and obtained their training there.

I have endeavored to note the merits and deficiencies of all these men as well as my own shortcomings, or lack of preparation, and want to give you to-night, first, a few of the lines along which I think you would do well to work in your chemical preparation, and, second, sketch a few of the industries which show a good future for the chemist and a few of the problems that confront him there.

The selection of the subjects to be considered will be a purely arbitrary one. It will not at all be based on their comparative importance or extent, but will be determined solely by whether I happen to have first-hand knowledge regarding them.

This decision and restriction require no little firmness of mind. It shuts me out of nearly the whole field of modern chemical research and discovery. It would be such a delight to expatiate on radium and its emanations and allies, or the possible degradation of copper into lithium, or the fulfillment of our long hope of fixing atmospheric nitrogen, or the marvelous developments in electric furnace work and manufacture of alloys, or the changes taking place in the iron and steel industry, the explosives industry and the cement industry, or any other branch of chemical industry which has been undergoing revolutionary changes, regarding which I may have a smattering of information. But it is amazing how small and how prosaic one's information is, when it is restricted to those matters of which he has definite first-hand information.

Taking up now the deficiencies in knowledge or training which the young graduate chemist shows when he meets his first employer, the most striking one to my mind is his ignorance of the comparative *commercial* importance of chemicals; the comparative extent of their manufacture and sale. When you study chemistry as a science solely this question of commercial importance does not and should not arise. Indium should receive as much attention as aluminum or lead. The mere fact that one is bought and sold while the other isn't has no bearing whatever on their relation to the science of chemistry. And further, I do not want to be understood as indicating that chemistry should be taught in any other way than as a science. The business of the student during his four years here is to learn the fundamental principles underlying the various branches of chemistry, acquire a certain familiarity with its representative elements and com-

pounds, and study it as an art in so far as the various analytical and other methods used are applicable through *all* or most branches of chemical industry. To my mind it is no part of the duty of a university to turn out trained soap makers, acid makers, paint makers, etc., but it is her duty to turn out men whose knowledge of chemicals and the principles of chemistry is broad enough so that they can enter any of these industries and make themselves valuable.

The moment a man enters *any* branch of chemical industry then aluminum and lead and iron, we will say, become much more important than indium. This is a situation that will face *every* chemist; it follows that his training in the science and art should be supplemented by some knowledge of commercial chemistry before he leaves the university. Such materials as sulphuric, nitric, hydrochloric and hydrofluoric acid; ammonia, soda ash, sal soda, glaubers salt, epsom salt, copperas, blue vitriol, caustic soda, caustic potash, and the like, concern such a great variety of industries that the chemist is sure to come in contact with most of them in a commercial way. His employers and associates, often not themselves chemists, will have a certain fund of information regarding such materials; any lack of it on the part of the chemist at once produces the impression that he is only a "theoretical" chemist, which is the polite expression used in the trade to damn a man as absolutely useless.

The young chemist should know, for instance, the percentages and gravities at which ordinary acids and alkalies are sold, and his disgust for the Beaumé and Fahrenheit scales should not prevent his being familiar enough with both so that any figures given in either will convey distinct impressions to his mind. He should know in what packages and quantities these common chemicals are shipped and the basis on which settlement is made.

For instance, he should know that sulphuric acid is shipped in three different kinds of packages, tank cars, drums and carboys; that it is shipped in three different strengths of approximately 65, 78, 93 per cent. strength, besides some shipped as 98 per cent. and as fuming acid or 100 per cent. acid containing free sulphur trioxide. These strengths are known in commerce as 50°, 60° and 66°, 98 per cent. and fuming. In the same way he should know the character of package, commercial appearance and strength of nitric acid, mixed acid, hydrochloric acid, hydrofluoric acid, aqua ammonia, carbonate of soda and caustic soda. He should know the distinction between nitric acid and aqua fortis, the basis on which soda ash and caustic soda are sold, respectively, one being on the 48 per cent. strength and the other on the 60 per cent. of Na_2O. He should know that bisulphate of soda is sold by the carload, while bisulphate of potash is more likely to be sold by the pound. Glaubers, epsom, copperas, blue vitriol, magnesium oxide, magnesium chloride, zinc chloride, chlorides of tin, calcium chloride, barium peroxide, all of these substances should be familiar to him, and in each case he should know the kind of package and strength, and the approximate cost of the commercial product. In this connection, I think it would be wise in any museum of industrial chemistry to have two sections to which the attention of students is especially called. One section devoted to chemicals which can be produced according to good processes in large quantities, but which are still hunting for profitable uses, and another section devoted to waste products and by-products of all descriptions which it is desirable to convert into marketable goods. The student should also be thoroughly familiar with the phys-

ical appearance and properties of these common products as they exist in commerce, so that he may recognize it at a glance if a mistake in the kind or quality of material has been made, before this mistake has cost his firm a considerable sum of money. Such mistakes will occur so long as purely human agencies handle chemicals. One of the most ludicrous ones that has recently come to my attention was a case where a consignment of soft soap was delivered on an order for thick silicate of soda.

Of course, it may be urged that the chemist can acquire all this information after he has left the university, and this is readily granted. But the acquiring of the knowledge outside is usually tedious and difficult and only accomplished after the chemist has been repeatedly subjected to mistakes and embarrassment due to his ignorance. Then, too, many of us believe that chemistry is a profession, and if so it is as essential for the chemist to be familiar with the present situation and relative importance of the materials with which he has to deal, as it is for the physician or lawyer in his profession.

If the functions of the chemist, the engineer, the business man and the manager could be sharply divided in chemical manufacture so that the chemist would not be asked any questions excepting those which fall entirely within the field of pure chemistry, the demands on his training and information, of course, would be much smaller and the reward of his labors would be correspondingly decreased.

The next place where the young chemist is usually most ignorant and most in need of assistance to my mind is in his knowledge or lack of knowledge of materials of construction and their comparative ability to resist the action of common chemicals. In his university work beakers and flasks and test-tubes and porcelain and platinum dishes, and rubber and glass tubing have always been available and have usually been adequate in size and quality for all his purposes. As soon as he enters chemical industry other materials must be sought more durable than glass and less costly than platinum. What accurate information does he possess regarding the comparative merits of cast iron, wrought iron and steel, for example, in resisting the action of caustic soda solutions, of sulphuric, hydrochloric or nitric acids, chlorine, sulphur dioxide or sodium carbonate solutions. Where are copper and brass and lead necessary or permissible. Where can he use Portland cement or Pecora cement, or silicate of soda or fire clay or ordinary mortar in making tight joints or linings.

To illustrate take the metal copper. It is most valuable in making stills and condensers for wood alcohol, acetone, acetic acid, turpentine, etc., and its alloy brass is extensively used in valves. Yet its use often leads to serious difficulties.

For example, I have seen iron drums to be used for shipping aqua ammonia in which the inside seams had been brazed, and bottling machines for use in bottling ammonia solutions containing brass parts exposed to the liquor. In both cases the final products, of course, were beautifully colored but unsuitable for the market. Similarly I have seen both copper and brass work placed in position where they would be continuously exposed to acetylene containing its ordinary impurities, ammonia, phosphine, etc.

In all these cases there were chemists in charge. They probably knew in a general way something about the action of ammonia and acetylene on copper and copper alloys, but their information was not indexed in their brains under the head of materials of construction.

Take again the case of sulphuric acid,

which is probably manufactured in larger quantities and goes into more industries than any other chemical. As we noted above, it is sold in about five strengths of 65, 78, 93, 98 per cent. strength, respectively, and fuming acid in addition. All these grades of acid must be made, concentrated and shipped, and the first and most important question to be decided is the kind of material to use at each separate stage of the process.

You are all no doubt perfectly familiar with the general features of the process of manufacturing sulphuric acid by the chamber and the contact methods, using either brimstone or pyrites. At the risk of wearying you, I am going to take some time to sketch through these processes, keeping in mind continuously the extreme importance of a knowledge of the action of chemicals on materials used in the construction of apparatus. When sulphur or pyrites is used as the raw material a large amount of cast iron enters into the construction of the burners and very often they are made entirely of cast iron, this in spite of the fact that one of the first freshman experiments proves that when sulphur is burned in the presence of iron, the products unite to form a sulphide of iron. When brimstone is burned in cast-iron burners this same action takes place to a certain extent, but the coating of sulphide of iron formed protects the rest of the iron from injury.

When sulphur is burned in the form either of brimstone or of pyrites the greater part, of course, forms SO_2, but about 6 per cent. burns to SO_3. Either of these two gases may be moved continuously and without danger in cast-iron pipes regardless, within reasonable limits, of how hot they become. On the other hand, a certain amount of moisture, depending on the day and the location of the plant, passes in with the air used for combustion (unless especial precautions have been taken to dry it all) and appears in the SO_2 gases. If these gases are allowed to cool the moisture combines with SO_3 in the gas to form dilute H_2SO_4, which destroys cast iron very rapidly. At the point where the gases are cooled in the contact process, or enter the glover tower in the chamber process, the iron must be abandoned, and all the cast-iron pipes must be arranged to drain forward and not backward. This same feature comes up in making nitric, muriatic acetic and hydrofluoric acids, all of which attack iron rapidly, and still all are made in iron retorts or furnaces. The necessary precaution, of course, is that no part of the retort or furnace should be allowed to cool enough to permit any condensation to form liquid products. If the retort is not properly insulated at any place a hole eats through with amazing rapidity.

Returning to the sulphur dioxide gases, then, we must change from cast iron to lead as soon as the temperature goes low enough to permit condensation. This material is not attacked by weak sulphuric acid. We, of course, could not use lead all the way back to the furnaces, as the excessive heat would melt it. In the chamber system the gases must now continue in lead throughout. In the contact system the sulphuric acid is filtered out after cooling and the gases continue their course in cast iron and steel to the very end without danger.

In concentrating H_2SO_4 still more interesting details arise regarding the materials that may be used. Many have been suggested, and among others glass and porcelain have been used with more or less success. But a factory is no place for glass and porcelain apparatus if any other materials can be found. The four materials now in fairly common use are lead, cast iron, volvic lava and platinum. Lead may be used so long as the acid does not

exceed 80 per cent. in strength and so long as direct heat is not applied. Platinum is satisfactory while the acid is between 80 per cent. and 94 per cent. strength, but the installation is very expensive and the loss of platinum is very large if an attempt is made to concentrate above 94 per cent. Cast iron is very satisfactory between 88 per cent. and 98 per cent. Below 80 per-cent. its life is too short to be considered. Cast iron is always attacked in any case, but it is usually cheaper to use cast-iron pans for six months or so and then replace them than it is to make more expensive installations. Fortunately only a small proportion of the iron dissolved by the acid from the pans remains in solution in the acid; nearly all of it is in the form of a sulphate of iron almost insoluble in either water or sulphuric acid, so it readily settles out, leaving a clear acid.

Where it is desired to produce 98 per cent. acid by concentration, a common custom is to evaporate in lead pans by waste heat to 78 per cent., then in platinum stills by direct heat to 93 per cent., then in cast-iron stills to 98 per cent. What evaporates from the lead pans is mainly water and is disregarded. The evaporation from the platinum stills forms a 35 per cent. acid, which can, of course, be condensed in lead. That from the cast-iron stills is over 90 per cent. and must be condensed in platinum. If the acid to be evaporated contains much sediment, as is liable to be the case when it is made from pyrites, or if the platinum stills are allowed to become dry and burn, they may be nearly ruined in a single night by a careless workman. The only material to use in mending the leaks which frequently occur in the platinum stills is gold. This seems rather startling when we consider that the acid itself is sold in quantity for less than a cent a pound, while the brimstone from which it is made costs more than a cent a pound.

Another common and satisfactory arrangement where it is only desired to concentrate up to 93 per cent. strength, is to evaporate in lead pans by waste heat up to 80 per cent. and feed this 80 per cent. acid directly into a large cast-iron still of such capacity that the whole body of acid in it always averages over 90 per cent. This prolongs the life of the iron often to two or three years, instead of its usual life of three to six months.

The distillate from such an iron still can, of course, be condensed in lead, but the upper part of the still itself would soon be eaten out by the weak distillate unless it were lined with acid brick or repressed red brick set in Portland cement neat, or mixed with silica or fine asbestos. Portland cement will stand the action of hot weak sulphuric acid for a very considerable time. A still of this type, if properly cared for, usually meets its end from cracking rather than from eating through. This is due to the caking of the peculiar sulphate of iron, which I mentioned above, on the bottom of the still to such an extent that the heat cracks the iron. When such an accident occurs there is, of course, a delay in operation, which is always expensive, aside from the cost of the new still and possibly a loss of several tons of acid.

Concentration in apparatus made of volvic or volcanic lava rock by driving hot furnace gases directly over and through the sulphuric acid is very satisfactory. The cost of installation is large, but not so large as that of platinum. The lava rock used comes from a mountain near Clermont-Ferrand in central France and so far no satisfactory substitute for it has been found in this country, although a number have been tried, among them some of the hard red sandstones of New York. In the volvic lava concentrating apparatus the

stones are liable to crack from heat if stilling is pushed too hard, and, of course, the lead and porcelain parts of the apparatus give out repeatedly.

In making sulphuric acid by the chamber process, the chambers of course are entirely made of lead; but as nitric acid and nitrogen oxides are mixed with the sulphur dioxide gases the strength of sulphuric acid in the chambers can never be allowed to fall below 45°; otherwise it will dissolve nitric acid in sufficient quantity to attack the lead very rapidly. If, on the other hand, the strength in any chamber is allowed to go above 55° nitrogen oxides are dissolved which also attack lead. Between 45° and 55° strength, however, almost no nitric acid or nitrogen oxides are dissolved and the chambers are safe. The action of nitric acid on lead chambers is very insidious and its affects are difficult to detect until a hole finally comes through the lead, probably simultaneous with the descent of several tons of acid.

I might go on to discuss acid eggs, pumps, sprays, piping, tower filling and tanks of a sulphuric-acid plant. In every one of these a careful consideration of the strength and temperature of acid is necessary before we can determine what materials are best or are even to be considered in its construction. I might go on to other industries and discuss why, for instance, in C.P. acids we are reduced to the use of glass, porcelain or platinum, while for C.P. ammonia iron is perfectly permissible, and for pure acetic to be used for vinegar none of these will do (except possibly glass), but we must use silver. Go through every branch of chemical industry, undertake to transport any chemical reaction from a laboratory to a works, and the very first problem that confronts you is what material to use in making your apparatus. The thing I want to impress on you is that you can not make a chemical, you can not make a thing in a chemical works without something to make it in, and the choice of that something is exceedingly important and worthy of serious consideration.

The next line upon which I would recommend the young chemist to be better equipped than chemists usually are, is in his knowledge of power accessories and transmission machinery. I do not mean that he should have any extensive knowledge along these lines, but he should certainly know the principles of a steam engine, how to start and stop it and when it is running properly. He should know the principles of boiler construction and boiler setting and how to care for a boiler; what amounts of fuel can be burned on a given grate surface, what evaporation may be expected from this fuel, and what power it will furnish, and what temperature and analysis of flue gases may be considered economical operation. He should know about steam pumps, their valve arrangement and how to compute their capacity under various pressures. He should know centrifugal pumps and under what circumstances they may be used; blowers plus pressure blowers and exhausts, mechanical stirring apparatus, shafting and pulleys and how to place them. By all this I do not mean that he should be an expert in factory design, or even a millwright or pipe fitter, or engineer or stoker, although he would certainly be much better equipped if he did have all these accomplishments. Yet all these things I have mentioned are the very tools of his trade, they are his beakers, and bunsen burners, and suction pumps, and stirring rods and steam-baths. If the young chemist gets on at all in manufacturing or using chemicals he must use all these appliances, and men working under his direction must manipulate them all, so it seems to me the part of wisdom

for him to assimilate all the information along these lines that comes his way.

At the same time the chemist should know his limitations. He is not an engineer and does not pretend to be; he simply reaches out for that small portion of the field of engineering where machinery comes in contact with his chemicals. In this limited field he may acquire and pretend to special information, but beyond it he would do well not to go. Let him rather call his brother engineer into consultation when he gets beyond his depth, so that the brother engineer may in return more readily call the chemist in consultation, to the mutual advantage of both.

The next place where I think the average chemist's stock of information could be profitably enlarged is in his knowledge of what industries use the common chemicals and how they use them. You will notice throughout that I use the term common chemicals. I realize perfectly that if a young man undertook to inform himself fully and broadly regarding all chemicals, along the various lines I have indicated from the beginning of this address, he would die of old age before graduation. Throughout all I have said I refer only or mainly to the three or four dozen chemicals which are largely used and widely distributed. Chemicals are manufactured for one purpose and only one—to make money. Chemicals are used for one purpose and only one—to make more money, and the sooner a chemist learns how and why this and that chemical is used the more valuable he becomes to himself or his employer.

Two mottoes that might well adorn the walls of any chemical works, judging from the view-point of the owners, are: First, "This is not a charitable institution"; second, "If you can't make good get out."

A student in an institution like your university here is furnished with every opportunity and every facility for either practise or investigation work, and no expense is considered too great if it leads to a discovery of some new fact, new law or new relationship of chemicals. The student at the same time is surrounded by a group of thoroughly trained investigators ready and willing to give him information or direct him where to obtain it.

When the chemist is in actual practise, however, he is usually discouraged in spending either time or money in any work which does not show very strong probability of bringing fairly immediate returns. He is in a position of one who is expected to give information, not to receive it, and the answer to the questions asked him is not always found in the back of the book.

Going back to the details of uses of common chemicals, the chemist will be required to have more or less familiarity with a great number of industries such as rubber, glass, leather, tanning, silk, cotton, ice-making, cement, etc., in order to know what kind of chemicals these industries use and what grades of chemicals they require.

To résumé the chief points to which I think young chemists do not pay sufficient attention and do seem to me of extreme necessity in their work are, first, a knowledge of the commercial importance of chemicals and the availability of these chemicals. Second, a knowledge of the action of common chemicals on materials ordinarily used in the construction of apparatus. Third, a knowledge of power accessories and transmission machinery. Fourth, a knowledge of the industries in which common chemicals are used and how they are used; and last, a knowledge of the impurities existing in the common chemicals as they appear on the market.

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THE SCIENTIFIC WORK OF THE SAN DIEGO MARINE BIOLOGICAL STATION DURING THE YEAR 1908

THIS year puts the Marine Biological Station of San Diego farther forward on the road to its ideals than has any single year of its previous existence. This results primarily from the circumstances that this year a new boat, the *Alexander Agassiz,* ample for the operations at sea, has gone into commission, and that more funds than hitherto have been available for running expenses.

"A comprehensive biological survey of the waters off the coast of southern California" has been announced from the outset as the station's scientific program. Such an expression of aims is surely somewhat vague; it might be looked upon as somewhat visionary or grandiose, and at least impracticable if any definite meaning be attached to the word comprehensive. Since it is now affirmed that real progress is being made toward realizing the aims, it ought to be possible to show wherein these aims are not wholly vague, are not in spirit grandiose, and are within limits of practicability.

On the theoretical side all, or at any rate much, does indeed hinge on the meaning of "comprehensive" as used in the preamble. It expresses an attitude or standpoint relative to biological research generally, rather than a determination to study every creature exhaustively regardless of rhyme or reason, that may happen to enter or may have a permanent home in these waters. What that attitude is may be stated thus: *To know, to understand organic beings is the object of biology. No phenomenon essential to the life-career of any organism can be pronounced as fully explained so long as any other phenomenon likewise essential to that same life-career is entirely unknown or entirely ignored.* Such is the conceptual matrix in which is set every plan made, every dollar expended, every day's work done, every page printed, at least so far as the scientific director is concerned, in connection with the San Diego Station.

Even allowing the conception to be right, does not the proposal to embody it in an institution of research mean certain failure from the simple fact that it runs counter to the principle of specialization, the principle which has been the king-pin of progress in all recent science? On the face of the matter it looks that way. In truth, though, violence to the principle is neither intended nor done. Quite to the contrary, specialization even more refined and intense than ever, is compelled at some points. The only unusual thing is that the program calls for specialization *in more directions* than is customary for one and the same institution; and that it gives this specialization *organic coordination* in greater measure than biological research has usually had.[1]

[1] On no account would I have the statement of aims of the San Diego Station seem to be oblivious of the similar work being prosecuted in various other parts of the world, especially in European seas. Our obligations to the International Council for the Investigation of the North European Seas, to the Prince of Monaco's extensive oceanographic enterprises, and to the Port Erin Station must be specially acknowledged.

Perhaps no better evidence can be adduced of our sensibility of dependence upon these agencies than by mentioning that Professor C. A. Kofoid, assistant director of the San Diego Station, who is spending his sabbatical year in Europe, is being paid a portion of his expenses by the station to enable him to see as much as possible of what these great enterprises are doing. It is our purpose to adopt the methods and apparatus used by the International Commission as far as may be.

The uniqueness of our program, if it has any, lies in the circumstance that being primarily biological rather than oceanographic, and being in its inception independent of any specified industrial motive, it can concentrate everything on whatever biological problems seem most inviting, most urgent or most accessible at any given time.

To make these generalities concrete, take the group of closely related, really inseparable problems comprised under the term distribution. I set for myself the task of finding what species of salpa occur in the area of the Pacific marked off for study. After some years of collecting I find a total of say eight species. By the time my studies have been extensive enough to make me nearly certain that no others are to be found, I have become keenly aware that some of these eight are much more abundant than others. Moreover, by watching the tow-net hauls as they come in from day to day and from week to week, and by running back over my records for some years, I make out, approximately at least, the order of abundance of the different species for the area. *S. fusiformis-runcinata* clearly heads the list, *S. democratica-mucronata* comes next, then probably, though not quite certainly, *Cyclosalpa affinis,* and so on. Again, my observations having reached over so long a period and over so much material, I could not fail to recognize certain rules according to which some at least of the species, *i. e.,* the more abundant ones, are distributed through the year and through the different depths of water. Intimations are found too of rules prevailing in the reproductive activity of the commoner species for both the sexual and the asexual phases of the life cycle. It seems that the different species reach their maximum abundance at different times of the year; that one species probably occurs at greater depths than another ever does; that the climax of abundance is brief for one species while more extended for another, and so on.

Were I willing to stop with commonplaces of zoology such as these, nothing would be required for my pursuits beyond efficient means of collecting (which in this case happen to involve considerable expenditure), some diligence in getting together, examining and recording material, and a little acumen in seeing and question-asking. But surely the knowledge thus gained is far from *full knowledge* of these particular animals. How comes it that *S. fusiformis-runcinata* is the most abundant species in these waters, while *S. cylindrica* turns up as hardly more than a straggler? Why, as has been the case this summer at least, does *S. democratica-mucronata* swarm in early June when *fusiformis-runcinata* is comparatively rare, while the latter species comes on by the millions in late July, the former being at this time a real rarity in the net hauls.

Must I look to environment or the constitution of the creatures, or to both for answers? The very fact that I ask the questions almost compels me to look to both. If I knew for a *certainty* that the full answer lay in either direction alone, I should quite surely know the answer *itself,* so should be under no necessity of asking the questions. Well then, if my questions are serious and I have gumption enough to seek the answers where obviously they must be sought, it will be necessary to go at the constitution of the animals more searchingly than before, and also at the environment. In other words, I have run with full force into the problem of *organic adaptation.* There is no doubt in my mind that much, if not the whole, of the species problem, so overshadowing in the biology of the last hundred or more years, has been befogged by the generality of idea and want of methodological accuracy with which this very subject of adaptation has been treated. Pinned down to something really tangible and definite, does not the question formulate itself in this way: ***In how far can the differentials between two kinds of organism be correlated with differentials in the environments which they respectively oc-***

cupy? Whether this formulary covers the whole case or not, it certainly reaches a good deal of it.

Immediately we see the problem take this form and resolve to tackle it on this basis we notice it to be in unison with at least two of the master principles underlying the soundest of progress in all physical science, viz., the principles of refined *quantitative treatment* and of *relativity*. I can make no real headway toward correlating kind-differentials among organisms with environmental-differentials without some measure of quantitative accuracy as to these differentials on both sides. If, for example, I find that *S. fusiformis-runcinata* flourishes equally well from the surface down to 350 fathoms while *S. democratica-mucronata* is never found deeper than say 50 fathoms, and if I am bent on finding out what there is, if anything, in the difference between the two animals that corresponds to the difference between 50 and 350 fathoms, I must bring these two sets of differences into an equation practically. This means that in order to give such a form of expression the real force of the mathematical equation, *i. e.*, to know that a known variable on one side must have a corresponding variable on the other, much, as a rule very much, quantitatively accurate data on each side will be necessary. And this means that a vast amount of observing, of comparing, and of measuring the animals themselves must be done. Thus much belongs to my province as a special student of these animals. For the physical data on the other side I am metaphorically as well as literally "all at sea." Do the kinds of organisms undergo their changes, reproductive, distributional, etc., which differ relatively to each other, within practically the same water, or is there different water corresponding to these changes? This calls first of all for knowledge of currents, which knowledge it is the business of a hydrographer to furnish. My own unaided attempts to get it would surely be wanting in reliability and furthermore would be made at the expense of time and energy that ought to be more profitably applied to tasks for which I am fitted.

Again, facts relative to the temperature, density and chemical composition of the water must surely enter into the environmental side of the equation. Who but a professional physicist and a professional chemist is fit to supply the data? The food of these species must be determined and at least some facts pertaining thereto must enter into the reckoning. No one but a specialist, perhaps several of them, on the groups of minute organisms which happen to constitute the dietary of salpa can furnish these data.

The long and short of all this is that it is impossible for me to handle the problems of species, distribution and adaptation of salpa with any large measure of success unless I can have the cooperation, not haphazard and incidental, but designed and sure, of specialists in several branches of science.

The object of this brief paper is to show something of what the present year means in the way of executing such a program at the San Diego Station.

The *Alexander Agassiz* is now ready to do any sort of at-sea work that the present main section of the program (planktology) calls for within the bounds of the area set off for investigation, *i. e.*, the area comprising the continental shelf from Point Conception southward to—Panama if necessary. The area in which most of our operations lie is about 15,000 square miles in extent and has a maximum depth of a little more than 1,000 fathoms.

I mention only one important point the craft has made during the summer concerning water-movements. By anchoring

on Cortez Bank about 95 miles off the coast, she has proved the existence of a northeast drift at this point for at least a portion of the year which is independent of tidal action. Published charts of the East Pacific and reports of navigators are conflicting as to such a drift. The prevailing view is, it seems, that it does not occur. The fundamental importance of reliable information on the question for problems of distribution of marine organisms in this locality hardly needs pointing out. How constant and extensive this drift is remains for future determination.

Thanks to the ingenuity of Professor C. A. Kofoid as a designer and to the skill of Messrs. Hensley and Baker, of San Diego, as mechanicians, a closing net is now in operation on the *Agassiz* that can be opened, towed and then closed at the same level, and at any depth in which the vessel can trawl. As a consequence I now have an abundance of *S. fusiformis-runcinata* that I know with certainty came from within a few feet of 350 fathoms, and likewise from various other intermediate depths. The mental comfort there is in the possession of information on this point about which there are no haunting doubts, is great and grows larger as one perceives the larger problems that hinge upon the trustworthiness of the data.

I may mention incidentally that the expenditures involved in this work at sea is not great relatively. What I mean by relatively is that the expense is small as compared with what such work costs when it is done in *coastal areas* by a vessel built and equipped for truly *oceanic areas and depths*. To illustrate: During March, 1904, through the good auspices of President D. S. Jordan it was my pleasure to have scientific direction of the United States Bureau of Fisheries Steamer *Albatross* for explorations on the coast of southern California. Excepting for about half a dozen trawl hauls made just beyond the edge of the continental shelf in 2,000 fathoms and over, the work of that period was in the same area and of the same general character as that now being done by the *Agassiz*. In almost all respects the advantages are surely with the *Agassiz*. The smaller vessel can be handled much more rapidly and surely, and can, of course, work in much shoaler waters, and has various other minor advantages that need not now be dwelt upon. Were the *Albatross* and the *Agassiz* both at the Station's command and both operable at the same expense I am quite sure we should use the *Albatross within our area* only on rare occasions. When work in specially rough waters became urgent we should want the larger vessel. It is only when depths beyond the continental shelf are to be explored that the large ship is needed, is in fact indispensable. Yet the *Agassiz* with her equipment represents an initial expenditure of less than $15,000 with a cost of operating amounting to about $22 per day (when a mooring can be made overnight), while the *Albatross* represents an initial expenditure of not less than $150,000 and a daily cost for operating of not less than $300.

This year, for the first time, a physicist has joined the staff as a regular member. Such equipment is supplied as is requisite for the investigations so far comprehended in the program. Mr. F. W. McEwen, an instructor in physics at the Leland Stanford Junior University, is the man in the place. About 400 density determinations have been made during June and July, reaching through depths to 400 fathoms. Naturally many more temperatures have been taken. The particular satisfaction in having a physical laboratory operating in conjunction with the biological work lies in the fact that whenever a special biological question comes along requiring informa-

tion from the physical side, the physicist can be appealed to *then and there*. That enables one to know what data either different or more of the same or relevant sort are to be sought. This is an advantage quite apart from that of having on hand a general stock, so to speak, of information about the water such as the systematic work of the physicist puts into the records.

As yet the station funds have not made possible a chemist and a chemical laboratory, but the addition of these in the not distant future is anticipated.

I may conclude by mentioning two other extensions of undertaking that stand to the credit of the present year. Miss Myrtle Johnson, of the station staff and a university student, has carried well forward a mensuration-mathematical study of growth and development of the zooids of the salpa chain. In this work Dr. J. Lipke, of the department of mathematics of the University of California, and Dr. Raymond Pearl, of Orono, Maine, have as a courtesy, rendered service without which the value of whatever results may be reached would be uncertain. Mr. S. E. Bailey, of the staff, has proven during the summer the practicability of determining with accuracy reaching to the fourth decimal place the weight of *Fundulus* eggs and embryos at various stages of development. The biological importance of investigations of this sort can not, I believe, be overestimated. This is no place to set forth the grounds of such belief although I may call attention to their obvious adjacency to such work as Minot in particular, has been doing recently on the weight of different animals at different periods of life.

Although the object of this communication is to indicate those aspects of the year's work that constitute a forward step in carrying out the general program of the Station, mention should be made of the fact that tasks under way for several years have by no means been neglected. Dr. Torrey made good progress in the description of the pelagic coelenterata; Mr. E. L. Michael, resident naturalist of the Station, has nearly completed a paper on the classification of the Chaetognaths of the region, and the director did something on the systematic treatment of the littoral ascidian fauna. Mr. Maurice Nichols, of the department of botany of the University of California, devoted much labor to the description of the corallanes. The usual work was continued of preserving and recording all collections brought in, preparatory to making them available for the various specialists who will report on them.

WM. E. RITTER

LA JOLLA, CAL.,
July 25, 1908

THE NATIONAL EDUCATION ASSOCIATION, IN CONVENTION ASSEMBLED AT CLEVELAND, O., JULY 1, 1908, DECLARATION

THE National Education Association, now holding its forty-sixth annual convention in Cleveland, and representing teachers and friends of education in every state in this union, makes the following declaration of principles and aims:

1. Fully realizing that trained and skilled labor is a primary essential to the industrial and commercial welfare of the country, we cordially endorse the establishment by municipal boards of education of trade schools, industrial schools, and evening continuation schools; and further recommend that the instruction in these schools be practical and efficient, and have the advice and the approval of the trade interested, to the end that graduates of these schools may at once become advanced apprentices or journeymen.

2. We recommend the subordination of highly diversified and overburdened courses of study in the grades to a thorough drill in essential subjects; and the sacrifice of quantity to an improvement in the quality of instruction. The complaints of business men

that pupils from the schools are inaccurate in results and careless of details is a criticism that should be removed. The principles of sound and accurate training are as fixed as natural laws and should be insistently followed. Ill-considered experiments and indiscriminate methodizing should be abandoned, and attention devoted to the persevering and continuous drill necessary for accurate and efficient training; and we hold that no course of study in any public school should be so advanced or so rigid as to prevent instruction to any student, who may need it, in the essential and practical parts of the common English branches.

3. We assert that the individuality of the pupil should be carefully considered, to the end that he may be instructed in the light of his limitations and capacity; and we commend to all local authorities the necessity of greater care in the arrangement of courses of study, that they may be adapted to the pupils to be instructed, rather than that pupils should be adapted to fixed courses of study and an inflexible system of grading.

4. The public high schools should not be chiefly fitting schools for higher institutions, but should be adapted to the general needs, both intellectual and industrial, of their students and communities, and we suggest that the higher institutions may wisely adapt their courses to this condition. We also suggest to school boards and superintendents the importance of securing for their high schools teachers who have not only abundant scholarship but also successful experience in teaching or efficient and practical training in pedagogy.

5. There is concededly a grave moral depression in our business and social atmosphere. The revelations of the financial and legislative world for the past two years denote a too general acquiescence in questionable practices and standards. We earnestly recommend to boards of education, principals and teachers the continuous training of pupils in morals, and in business and professional ethics, to the end that the coming generation of men of affairs may have a well-developed abhorrence of unfair dealing and discrimination. The establishment of the honor system in schools, the ostracism of the dishonest or unfair pupil, the daily exemplification in the routine life of the school of the advantage of honest and truthful methods, are commended to the especial attention of teachers as a partial means to this end.

6. The Bureau of Education at Washington should be preserved in its integrity and the dignity of its position maintained and increased. It should receive at the hands of Congress such recognition and such appropriations as will enable it not only to employ all expert assistants necessary, but also to publish in convenient and usable form the results of investigations; thus making that department of our government such a source of information and advice as will be most helpful to the people in conducting their campaigns of education. We are of the opinion that the importance of the subject under its control, and the dignity of this country require that this Bureau be maintained as an independent department of the government.

7. The National Education Association notes with approval that the qualifications demanded of teachers in the public schools are increasing annually, and particularly that in many localities special preparation is demanded of teachers. The idea that any one with a fair education can teach school is gradually giving away to the correct notion that teachers must make special preparation for the vocation of teaching. The higher standards demanded of teachers must lead logically to higher salaries for teachers, and constant efforts should be made by all persons interested in education to secure for teachers adequate compensation for their work.

8. It is the duty of the state to provide for the education of every child within its borders, and to see that all children obtain the rudiments of an education. The constitutional provision that all tax-payers must contribute to the support of the public schools logically carries with it the implied provision that no person should be permitted to defeat

the purposes of the public school law by forcing their children, at an early age, to become bread winners. To this end the child labor and truancy laws should be so harmonized that the education of the child, not its labor, shall be made the chief concern.

9. The National Education Association indorses the increasing use of school buildings for free vacation schools and for free evening schools and lecture courses for adults, and for children who have been obliged to leave the day school prematurely. We also approve of the use of school grounds for play grounds and the use of school gymnasiums and bath rooms for the benefit of the children in the crowded districts during summer.

10. Local taxation, supplemented by state taxation, presents the best means for the support of the public schools, and for securing that deep interest in them which is necessary to their greatest efficiency. State aid should be granted only as supplementary to local taxation, and not as a substitute for it.

11. The National Education Association observes with great satisfaction the tendency of cities and towns to replace large school committees or boards which have exercised executive functions through subcommittees, by small boards which determine general policies, but intrust all executive functions to salaried experts.

12. We cannot too often repeat that close, intelligent, judicious supervision is necessary for all grades of schools.

13. The rapid establishment of rural high schools and the consolidation of rural district schools are most gratifying evidences of the progress of education. We believe that this movement should be encouraged until the children of rural communities enjoy the benefits of public education to an extent approximating as nearly as practicable the education furnished in urban communities.

14. The National Education Association wishes to record its approval of the increasing appreciation among educators of the fact that the building of character is the real aim of the schools and the ultimate reason for the expenditure of millions for their maintenance. There are in the minds of the children and youth of to-day a tendency toward a disregard for constituted authority, a lack of respect for age and superior wisdom, a weak appreciation of the demands of duty, a disposition to follow pleasure and interest rather than obligation and order. This condition demands the earliest thought and action of our leaders of opinion and places important obligations upon school boards, superintendents and teachers.

15. It is apparent that familiarity with the English Bible as a masterpiece of literature is rapidly decreasing among the pupils in our schools. This is the direct result of a conception which regards the Bible as a theological book merely, and thereby leads to its exclusion from the schools of some states as a subject of reading and study. We hope for such a change of public sentiment in this regard as will permit and encourage the reading and study of the English Bible, as a literary work of the highest and purest type, side by side with poetry and prose which it has inspired and in large part formed.

16. The National Education Association wishes to congratulate the secondary schools and colleges of the country that are making an effort to remove the taint of professionalism, and other abuses, that have crept into students' sports. This taint can be removed only by leading students, alumni and school faculties to recognize that inter-school games should be played for sportsmanship and not merely for victory.

17. It is important that school buildings and school grounds should be planned and decorated so as to serve as effective agencies for educating, not only the children, but the people as a whole, in matters of taste. The school is becoming more and more a community center, and its larger opportunities impose new obligations. School buildings should be attractive as well as healthful, and the adjoining grounds should be laid out and planned with appropriateness and beauty.

18. The highest ethical standards of conduct and of speech should be insisted on among teachers. It is not becoming that commercialism or self-seeking should shape

their actions, or that intemperance should mark their utterances. A code of professional conduct clearly understood and rigorously enforced by public opinion is being slowly developed, and must one day control all teachers worthy of the name.

19. In teaching, as in every other kind of work, the best service is secured by finding the individual best fitted to the particular place as indicated by training, experience, and meritorious service; the National Education Association therefore heartily approves a merit system of promoting teachers and filling vacancies. We assert, furthermore, that the grounds upon which a teacher may apply for a position are preparatory training, experience, and meritorious service—in a word, professional fitness, alone; and that the use of other personal and political arguments to secure appointment is deplorable in the teacher and a serious menace to a high professional standard.

The foregoing principles and aims have been fully considered by the Committee and unanimously recommended to the Active Members of the National Education Association for adoption.

Respectfully submitted,

Committee on Resolutions:

Howard J. Rogers, *Chairman*,
of New York.
Orville T. Bright,
of Illinois.
Charles E. Chadsey,
of Colorado.
Edgar H. Mark,
of Kentucky.
George M. Philips,
of Pennsylvania.
David B. Johnson,
of South Carolina.

Adopted by unanimous vote of Active Members in session, July 1, 1908.

Irwin Shepard,
Secretary

CONGRESS ON TUBERCULOSIS

The *Journal* of the American Medical Association announces that the following physicians and scientific men expect to attend the approaching congress at Washington:

Belgium: J. F. Heymans, Ghent.

Denmark: Holger Rodam and Johannes Fibiger, Copenhagen.

Germany: G. Hormann, Munich; Mme. Lydia Rabinowitsch-Kempner, F. Meyer, G. Kirchner, Robert Koch, Gotthold Pannwitz and F. Helm, Berlin; F. Köhler, Werden a. d. Ruhr; Dumpf, Ebesteinburg b. Baden-Baden; W. Schwabe and Uhlmann, Leipzig; W. von Leube, Würzburg.

Great Britain: W. R. Smith, G. A. Heron, C. Theodore Williams, H. Horton-Smith and A. Latham, London; Sheridan Delépine, Manchester; Sims Woodhead, Cambridge; Nathan Raw, Liverpool; N. D. Bardswell, King Edward Sanatorium, Midhurst; R. W. Philip, Edinburgh; William Osler, Oxford.

France: Charles Baradat, Cannes; F. Barbary, Nice; A. Calmette, Lille; Dupeux, Bordeaux; A. J. Magnin and L. Landouzy, Paris; R. Hervé, Lamotte-Beuvron; A. Leune, Versailles, Arloing, Lyons; P. Gallot, Mentone.

Italy: Umberto Gabbi, Messina; Massalongo, Verona; Eduardo Maragliano, Genoa.

Greece: Bastile Patrikios, Athens.

Holland: C. F. J. Blocker, Voorburg; R. de Josselin de Jong, Rotterdam.

Norway: F. Harbitz, Christiania; Herm. Gade, Hagekiken pr. Bergen.

Austria: Reisinger, Komitau i Böhmen; Lang, H. von Schroetter, Bartel, C. von Pirquet and H. Riedl, Vienna; A. Taussig, J. Dvorack and T. Altschul, Prague.

Roumania: J. Mitulescu, Bucharest.

Russia: S. von Unterberger, N. Th. von Tschigaieff and A. A. Wladimiroff, St. Petersburg.

Sweden: Karl Petren, Upsala; K. O. Medin, Stockholm.

Switzerland: Spengler, Davos-Platz; Th. Exchaquet, Leysin; Egger, Basle.

Spain: Jose Chabas, Valencia; A. Martinez-Vargas, Barcelona.

Hungary: H. Preisz, Budapest.

COLLECTIONS OF MINERALS FROM ONTARIO

A prize of $100 is offered by Mr. J. B. Tyrrell, mining engineer of Toronto, for the

best collection of minerals collected in the province of Ontario during the year 1908 by any one not employed as a collector by a public institution or dealer in minerals. The collection must contain at least thirty mineral species, and it is suggested that where convenient the size of the specimens should be 2 x 3 inches. Each specimen must be labeled with the exact locality from which it was obtained, and the date on which it was collected. No specimen will be considered unless it is so labeled. A typewritten list of the specimens, with names of minerals and localities, in triplicate, together with a declaration stating that they were personally collected by the signer of such declaration in the province of Ontario in 1908 at the localities stated, with the post-office address of the collector, must accompany each collection. The collections must be addressed: "Examiners, Tyrell Prize, Government Assay Office, Belleville, Ont.," and must be sent, *prepaid,* to the Government Assay Office, Belleville, Ontario, on or before December 1, 1908, where they will be opened and examined jointly by Professor Nicol, of the School of Mining, Kingston, and Dr. Walker, of Toronto University. If requested the collections will be returned, charges collect, as soon as possible after the prize is awarded.

LECTURES ON HYGIENE AT CORNELL UNIVERSITY

IT is proposed to give next year at Cornell University a course of public lectures on hygiene and public health. These lectures are to be given in cooperation with the state department of health. A committee of the university faculty has adopted a provisional scheme for the first term under which the following course of lectures has been arranged:

October 8—Introductory lecture by President Schurman.

October 13 and 15—"Public Health Administration," E. H. Porter, M.D., State Health Commissioner.

October 20—"Epidemiology," Arthur Newsholme, M.D., health officer, Brighton, England.

October 22—To be announced; foreign visitor.

October 27—"The Relation of the State to the Health of the Rural Community," R. A. Pearson, State Commissioner of Agriculture.

October 29—To be announced; Dr. W. L. Russell.

November 3 and 5—"Social Problems in their Relation to the Public Health," Professor J. W. Jenks.

November 10 and 12—"The Public Health Law," A. H. Seymour, Secretary of the State Department of Health.

November 17, 19 and 24—"The Various Aspects of Vital Statistics," Professor Walter F. Willcox.

December 1—"Public Morality," John B. Huber, M.D., lecturer on tuberculosis, State Department of Health.

December 3—"The Influence of the Action of the Laws of Heredity upon Public Health," Professor S. H. Gage.

December 8—"Voluntary Organization in Public Health Work," Homer Folks, member of the tuberculosis advisory board, State Department of Health.

December 10, 15 and 17—"Bacteriology and Comparative Epidemiology," Professor V. A. Moore.

January 5—"Recent Results of Research upon Causation and Transmission of Malignant Diseases," Professor James Ewing.

January 7—"The Relation of Psychology to Preventive Medicine," Professor E. B. Titchener.

January 12 and 14—"Immunity and Epidemiology," Herbert P. Pease, M.D., director of the hygienic laboratory, State Department of Health.

SCIENTIFIC NOTES AND NEWS

PROFESSOR RUFUS I. COLE, of the Johns Hopkins University, has accepted the directorship of the Research Hospital of the Rockefeller Institute of New York City. He had previously declined the chair of medicine at the University of Michigan.

PROFESSOR HUGO VON SEELIGER, of Munich, has declined a call to the directorship of the Astrophysical Observatory at Potsdam.

DR. HOMER D. HOUSE has been appointed associate director in the Biltmore Forest School.

DR. RAYMOND H. POND, has been appointed biologist of the Metropolitan Sewerage Commission of New York.

The Oklahoma Geological Commission, consisting of the governor, the state superintendent of public instruction and the president of the state university, met for organization on July 25. Governor Haskell was elected president of the commission, Superintendent Cameron, secretary, and President Evans, executive officer. Dr. Chas. N. Gould, professor of geology at the State University of Oklahoma, was elected director of the survey and instructed to begin at once the preparation of reports dealing with the geologic structure and mineral resources of the state.

Dr. Harvey W. Wiley, chief of the Bureau of Chemistry, Department of Agriculture, has been appointed honorary president of the First International Congress for the Repression of Adulteration of Alimentary and Pharmaceutical Products, which will meet in Geneva, Switzerland, beginning September 8.

Professor Freiherr Adolf v. la Valette St. George, professor of anatomy, at Bonn, has celebrated the fiftieth anniversary of his doctorate.

Dr. Antonio Lagorio is taking treatment at the Chicago Pasteur Institute, of which he has charge, on account of infection from a wound from the bone of a rabbit which had been inoculated with rabies.

We learn from the *Journal* of the American Medical Association that the professional silver jubilee of Professor Julius Dollinger, of Budapest, was celebrated recently by his friends, and the last issue of the *Orvosi Hetilap* was expanded into a *Festschrift* in his honor. His present and former pupils contributed a number of interesting articles on various phases of surgery and orthopedics, Dr. Dollinger having been docent in the latter specialty before he was appointed to the chair of general surgery. The recent systematic organization of cancer research in Hungary is also his work.

The silver medal of the Zoological Society of London has been awarded to Sir William Ingram for his gifts of birds of paradise to the society's collection.

At the suggestion of the director of the Aeronautical Observatory at Lindenberg, Prussia, Professor Arthur Berson and Dr. Hermann Elias, of the observatory staff, have been sent to East Africa to make meteorological observations in the upper air by means of balloons and kites, on the days that have been assigned for international cooperation in these investigations.

According to a press despatch, Lieutenants Colin, Jeance and Mercier, of the French navy, have obtained excellent results with a wireless telephone of their invention. Communication has been maintained between Paris and a wireless station at Raz de Seine, Department of Finistère, a distance of about 300 miles.

A monument to the memory of Richard Freiherr von Krafft-Ebing will be unveiled in the court of the University of Vienna on October 6.

Mr. Harry Day Everett, superintendent in the Philippine Forest Service, was murdered by natives in the island of Negros in the early summer. He had been a student of forestry at Cornell and Michigan and was twenty-eight years of age.

Dr. Jacob Farnum Holt, professor of anatomy, physiology and hygiene at Philadelphia High School, died on August 31.

Mr. Frank B. Kleinhaus, mechanical engineer at Pittsburgh and scientific author, was killed through a collision of an electric car with his carriage on September 2. He was thirty-nine years of age.

The death is announced of Dr. Charles Taylor, master of St. John's College, Cambridge, known for his work on geometrical conics and as a theologian.

Dr. Hermann Settegast, professor of agriculture at Berlin, has died at the age of ninety years.

The department of superintendence of the National Education Association will meet at Chicago, on February 23, 24 and 25, 1909.

The use of the metric system of weights and measures will be compulsory in the Philippine Islands after January 1, 1909.

Nature states that some interesting experiments on coal-dust explosions have been started under the direction of Mr. W. E. Garforth, at the Altofts Colliery, Yorkshire. An experimental explosion was witnessed on August 14 by Mr. E. Reumaux (Lens), Dr. J. A. Holmes (United States Geological Survey), Captain Desborough, H.M., inspector of explosives, and a number of experts from France and the United States. The cost of the experiments is borne from a special fund of £10,000 contributed by colliery proprietors.

THE president of the British local government board has authorized, as we learn from the *Journal* of the American Medical Association, the following researches in connection with the annual parliamentary grant in aid of scientific investigations, concerning disease: (1) A further inquiry by Dr. H. M. Gordon into the character and differential tints for the microbes in the throats of patients suffering from scarlet fever. (2) An investigation of protracted and recurrent infection in diphtheria by Dr. Theodore Thomson and Dr. C. J. Thomas. (3) An investigation of protracted and recurrent infection in typhoid fever by Dr. Theodore Thomson, in conjunction with Dr. Hedingham. (4) Investigations by Dr. V. G. Savage into the presence of paratyphoid bacilli in men, the differentiation of streptococci in goats and the bacteriologic measurement of pollutions in milk. (5) A statement of the results of bacteriologic examination of over 7,000 samples of milk from different parts of the country by Professor Delépine. (6) An investigation of the rôle played by flies as carriers of disease, by Dr. Copeman and Professor Nuttall. (7) An inquiry into the condition of flock bedding by Dr. Farrar. The bacteriology and biology of bedding will be undertaken by Professor Nuttall. (8) A statistical inquiry into the social incidence of disease will also be begun.

Petermann's Mitteilungen, as quoted in the *Bulletin* of the American Geographical Society, gives further particulars concerning the expedition which the Swedish government has despatched to Spitzbergen in charge of this well-known geologist. The purpose is geographical and geological research. It is expected to make a more exact survey of the coasts of Ice Fiord and to map the glaciers tributary to it. Excursions inland will be made to ascertain what changes the glaciers have undergone since they were last studied. Many photographs of the glaciers will be taken. The party includes the geologists, C. Wiman, B. Högbom and S. de Geer, the brother of the leader; the zoologist, N. von Hofsten; the photographer, O. Halldin, and the cartographer, E. Jansson. The expedition was taken to Spitzbergen by the gunboat *Svensksund,* whose officers were instructed to make soundings and engage in other hydrographic work.

MR. HARLAN I. SMITH has returned from an archeological reconnoissance of northeastern Wyoming, made in continuation of the work which he started last year for the American Museum of Natural History. The work already accomplished is only the beginning of an investigation into the archeology of a vast region, including the Great Plains, the Barren Lands and the Plateaus of America—a region larger than the entire remaining portion of the continent and regarding which there is practically no archeological knowledge or available specimens from which to secure such knowledge. Among the general problems which are awaiting elucidation may be mentioned the following: (1) When the region came to be first inhabited; (2) what the material culture of the people was; (3) whether people were living in the region before the introduction of the horse, and, if so, how the coming of this valuable animal affected their culture; (4) whether there was more than one culture in the region, and, in this event, where the boundaries of these culture areas may be found. While, on the whole, the results of the two archeological trips to Wyoming would suggest that that particular region was not inhabited until after the advent of the horse, yet such a conclusion can not be definitely reached without an accumulation of such negative archeological evidence, or without making sure that mythological, ethnological

or historical evidence may not lead to a contrary result.

An additional construction appropriation of $25,000 for the New York Botanical Garden, voted on June 26, and approved on August 4, will be expended in the continuation of construction of driveways and paths, principally on the eastern side of the grounds, in the completion of the grading operations necessary at the museum building, in the extension of the system of water-supply and drainage, and for minor works. All the earth and rock to be excavated at the museum building is required for filling and for telford foundation of roads and paths, so that the same money will effect two pieces of work, as has been the case in nearly all the grading operations hitherto accomplished, a result made possible by following the original plan of development approved by the Board of Managers in December, 1896. It is now planned to complete the driveway system and to build at least an additional mile of paths.

According to *Charities* reports from Alaska through a special charge to the Grand Jury sitting at Juneau show that tuberculosis, trachoma, and other diseases are spreading to such an extent among the Indians that their very existence is threatened. From the data furnished it would appear that within a few decades, if the mortality of the race continues as in the recent past, there will be no longer any native inhabitants. The statistics taken from a typical settlement of the natives, show a greater mortality than that of any other primitive race which has come in contact with Anglo-Saxon civilization. An appended report by Army Surgeon Paul Churchill Hutton states that he doubts if any country in the world can show such a percentage of tuberculous natives, and the mortality from this disease is really terrible. He proposes that Alaska be divided into sanitary districts and that sixteen sanitary officers be appointed. He also suggests that an intelligent Indian inspector be appointed for each town having 200 or more inhabitants, and that each Indian inspector study under the regular inspector and disseminate his knowledge among his own people.

The work accomplished by the Reichsanstalt last year, according to an abstract of the annual report in *Nature*, includes the following: In accordance with a commission received by the institution, tests were started on the exact measurement of very small pressures (of the order of between 10^{-6} and 10^{-3} mm.), the pressures being determined from the deflection of a metallic membrane of 25 cm. diameter by means of the Fizeau interference method. The absolute velocity of sound in dry air (free from carbonic acid) has been investigated and found to be $33{,}192 \pm 5$ cm. per second. Dr. Scheel has tested some further materials for expansion between $-191°$ and $+16°$ C. with the Fizeau dilatometer described in the previous year's report, and has obtained results varying from 2,120 microns per meter for palladium to -41 microns per meter for quartz glass. Scheel and Schmidt have obtained a much lower value for the refractive index of helium than that found previously by Lord Rayleigh and by Ramsay and Travers, the figures of the former being 1.0000340. Some useful work has been done in regard to the specific heat of nitrogen, CO_2 and water-vapor, up to 1,400° C., and experiments to determine the saturation-pressure of water-vapor above 100° C. have been commenced. In the Electrical Standards Department the variations in manganin resistances have been found to be very slight and the "humidity effect" only just perceptible. Resistance coils are now being wound on metallic spools with longitudinal slots to render them somewhat flexible; in this way it is hoped to make any effect due to humidity practically negligible. Measurements of the wave-length of electric oscillations can be made with an accuracy within 1 part in 1,000 for long waves (above 1,000 meters), and for shorter wave-lengths the accuracy is within 1 per cent. Other experiments have been made with undamped electric oscillations produced after the Poulsen method by means of an arc burning in oxygen. A research of importance to opticians was carried out in regard to the secular variation of the planeness of surfaces of optical glasses,

results being given in the report. In addition to the researches mentioned, a number of routine tests were carried out in the various departments of the Reichsanstalt, some of these yielding interesting results from a commercial standpoint.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of the late Senator William F. Villas the University of Wisconsin will ultimately receive his entire estate, valued at between two and three million dollars. By the provisions of the will, Mrs. Villas receives the income during her lifetime, and after her death her daughter receives $30,000 a year. After the property is given to the university, part of the income will be reserved until the principal becomes $30,000,000. The will provides for the erection of a Henry Villas Theater, and for the establishment of ten professorships, each with a salary of not less than $8,000, nor more than $10,000 a year.

BY the will of Frederick Cooper Hewitt, Yale University receives $500,000; the New York Post-graduate School and Hospital $2,000,000, and the Metropolitan Museum of Art $1,500,000 and the residue of the estate.

THE General Education Board has offered Richmond College, at Richmond, Va., $150,000, on condition that an additional $350,000 be subscribed.

NORWICH UNIVERSITY, at Northfield, Vt., receives an unrestricted endowment of $100,000 by the will of Colonel C. S. Barrett, of Cleveland, O.

MR. W. J. HORNE, lecturer in physics at the South African College, Cape Town, has been appointed to the inspectorate of the Transvaal Department of Public Education as organizer for technical education.

DISCUSSION AND CORRESPONDENCE

THE AMERICAN SOCIETY OF NATURALISTS

TO THE EDITOR OF SCIENCE: Whether the American Society of Naturalists should be preserved or not depends on whether it has an important work to do and whether its work can be coordinated with that of other societies so that it shall be regularly called upon to perform its proper functions. I, for one, think it has a more important potential part to play than ever before, but whether it shall be permitted to play that part depends upon the cooperation of naturalists in general.

It is argued by those who regard the Society of Naturalists as an anachronism that natural history is no more, that in the differentiation and specialization that accompany the development of science it has broken up into botany, zoology, etc., and that these special sciences are each amply provided for by at least two national societies. It does not, however, follow because we have societies of students of plants, ferns, animals, birds, pigeons, carrier pigeons, insects and butterflies that the Society of Naturalists has become unnecessary. I conceive that even if we had a national society for each *genus* of animals and plants there would still be biologists who would find in a grand meeting of such societies no home. Indeed, the more you multiply societies on the basis of the material studied the more need for a society which shall bring together for mutual conference persons working on the general biological *topics* that are common to plants, animals, insects, butterflies. Our modern societies work directly against such a result. I may be working on heredity in insects and you on heredity in violets, but we hardly speak as we pass by because, forsooth, you are a botanist and I am a zoologist. Consequently we attend different meetings and we fraternize with different colleagues while we read papers of precisely the same theoretic import at the same time in buildings far apart, you to your colleagues who are interested in fossil cycads, in the hourly rate of growth of a gourd, in the development of a moss, or in a bog-society, and I to my colleagues who are awaiting their turn to tell of their discoveries in the circulation of an earthworm, in the properties of a new nerve stain, in the bird fauna of Christmas Island and the distribution of the Characinidæ of Brazil. No wonder we have so little discussions at our meetings with the diversity of interests represented and the scattering of

workers on the same topics because they are working on different species.

What is the remedy? Seek an association of workers on *general* biological topics (of interest to more than one of the "sciences") for the presentation and discussion of the results of investigations on such topics. Such an association is already organized. The American Society of Naturalists is dignified by years of service and a membership that includes the most eminent of American biologists. Except in its early years it has been, as it now is, almost exclusively a *biological* society. For some years one of its principal functions has been to arrange for a discussion on some general biological topic. Matters of common interest to biological investigators would seem, therefore, to be its peculiar province. Consequently it can provide the required machinery for bringing together workers on general biological topics.

To meet the need the Society of Naturalists must extend somewhat its work and to do this the cooperation of the other scientific societies is essential. The society has been told for so long that its function is only to provide a discussion, an address and a dinner, that we have come to believe it. But, if it is necessary for the advancement of biological science that the naturalists should expand, recent tradition must not be permitted to stand in the way. Will the societies of anatomy, anthropology, bacteriology, botany, palentology, physiology, psychology and zoology authorize their respective secretaries to constitute, together with the secretary of the Naturalists, a general biological executive committee to select a program for one day of the meeting period, which shall replace that of their individual societies? This day's program might consist entirely of "papers" or in part of "papers" and in part of a symposium. Time should be left for discussion. If the respective societies will do this then, I believe, "general biology" will receive a great impetus in this country.

One more point of great importance and difficulty is the relation of the American Society of Naturalists to the American Association for the Advancement of Science; for if the Society of Naturalists has a rôle then it must not be crushed out, but fitted into a scheme. I suggest that it should seek to affiliate itself with the association on some such terms as these: The Society of Naturalists to be accepted as the Biological Division of the American Association for the Advancement of Science, and to have certain privileges on the council—its president to be first vice-president of the association, or something of the kind—to have general charge of the matters of common interest to Sections F, G, H and K, so that such matters shall be acted on by the executive committee of the Society of Naturalists before being adopted by the council of the American Association for the Advancement of Science. The Naturalists should continue its affiliation with the technical biological societies; thus it could serve as a needed medium between the technical biological societies and the biological sections of the American Association for the Advancement of Science, on the one hand, and the council of the American Association for the Advancement of Science, on the other. The proposed relation may be graphically expressed in the following scheme:

AMER. ASSOC. FOR THE ADV. OF SCIENCE		
Sect. A	(American Society of Naturalists)	
Sect. C	Sect. F	Amer. Anthropological Soc.
Sect. B	Sect. G	Amer. Physiological Soc.
Sect. D	Sect. H	Amer. Psychological Assoc.
Sect. E	Sect. K	Amer. Soc. Vertebrate Paleontologists.
Sect. I		Amer. Soc. of Zoologists.
		Assoc. of Amer. Anatomists.
		Botanical Soc. of America.
		Soc. of Amer. Bacteriologists.

Occupying the suggested position and managed by a committee of all the secretaries of the sections and independent societies listed above, the Naturalists could fulfill a number of important functions. It could arrange for joint meetings of the independent societies so as to secure a special rate; it could seek to minimize conflicts of programs when a technical society meets with the corresponding

section; it could arrange, as suggested above, for a program on general biological topics; it could, in its general meetings, take such action as it might see fit to advance any particular biological interest of common import.

It is not too late for the executive committees of the different technical societies to direct their secretaries to cooperate with the secretary of the Naturalists in arranging a general program for the Baltimore meeting.

CHAS. B. DAVENPORT

THE HIGHEST BALLOON ASCENT

TO THE EDITOR OF SCIENCE: I notice that Dr. Chanute in his review of "Airships, Past and Present," SCIENCE, July 3, 1908, says, "The greatest authentic height [in a balloon] attained by man has been 35,500 feet." In Hill's Chemistry for students of Medicine, Pharmacy and Dentistry (1903) the following occurs: "A balloon may rise to a great height, because of its great volume of gas ligter than air. The highest ascent was that of Glaisher in 1861, who attained an elevation of over 36,000 feet." This is found in the chapter on medical physics, page 18.

G. T. OVERSTREET

LOUISVILLE, KY.

[M. Glaisher (September 5, 1862) became unconscious at a height of about 29,000 feet, while still rising at the rate of 1,000 feet per minute. He was again able to make observations after thirteen minutes, at a height of about 26,000 feet and found that he was falling 2,000 feet per minute. From these data and from other corroborative circumstances he estimated that, in the interval, he had reached an altitude of 36,000 to 37,000 feet, but this has not been accepted as authentic. M. Berson's performance (July 31, 1901) is better established. Going up with a provision of compressed oxygen he took an observation at 34,500 feet, while still rising, and then became partly unconscious. He probably rose another 1,000 feet and certainly reached an altitude of 35,500 feet, or possibly of 36,000 feet. He had previously judged that human life was impossible at a height of 36,100 feet and that Glaisher could not have reached it, as "no human being has penetrated to such heights either before or since without taking a supply of oxygen."—ED.]

SALARIES AT BRYN MAWR COLLEGE

TO THE EDITOR OF SCIENCE: In SCIENCE for August 14 appears a letter from Professor David Wilbur Horn, of Bryn Mawr College, criticizing certain financial data concerning that college, which had been reprinted in SCIENCE from a recent *Bulletin* of the Carnegie Foundation.

I venture to call attention again to the fact emphasized on the first page of this *Bulletin* that the statistical data published by the foundation were obtained in all cases directly from the authorities of the institutions themselves. In the case of Bryn Mawr, the statistics were furnished by President Thomas and had apparently been prepared with great care, all the items being in her own handwriting.

HENRY S. PRITCHETT

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING

QUOTATIONS

THE TRIUMPH OF SANITATION AT PANAMA

THE redemption of the Panama Canal Zone from preventable diseases receives official confirmation in the report to President Roosevelt of the special commission appointed last April to investigate the work accomplished. The importance of the hygienic problem involved is emphasized by the commission in reviewing the difficulties under which the French labored in their efforts to construct the canal. The report says:

> The terrible scourge of yellow fever against which the French struggled in vain, the filthy and pest-breeding state of the principal Panama towns, the rough labor camps and other pioneer hardships of the first two eras have been eliminated through the brilliant and persistent activity of the department of sanitation, the department of municipal engineering and the building department. To-day we find yellow fever driven from the isthmus, malaria and pneumonia greatly reduced and a high average of health established. Although the government's immediate object on the isthmus is to dig the canal and to provide living quarters for a temporary enterprise, it has, in fact, created comfortable homes and well-organized social communities for its working force.

Modern civilization furnishes no better example than this of the possible victory over pestilence and disease, when the warfare is carried on in the light of modern scientific knowledge. The building of the Panama Canal and the sanitary record of the Japanese in their war with Russia are the two great object lessons of recent years, demonstrating that men can neither work nor fight to the best advantage unless protected from infectious and preventable diseases. The civilized nation which will hereafter put an army in the field or undertake a great engineering problem without first preparing the way by proper and adequate sanitary engineering and equipment will be regarded by the other nations as quite as foolish as a government which would build a vast fleet of modern warships and then arm them with the muzzle loading ordnance of one hundred years ago. An epidemic of typhoid fever in a military camp should be considered a greater disgrace to an army than a defeat in battle, since defeat may come in spite of the greatest exertions and the highest wisdom, while typhoid and yellow fever would be the result of ignorance or disregard of well-known laws of prevention. All nations will profit by the sanitary lesson of the Panama Canal.—*Journal of the American Medical Association.*

SCIENTIFIC BOOKS

General Chemistry for Colleges. By Alexander Smith. 8vo, pp. 529. New York, The Century Co. 1908.

This book is practically a somewhat abbreviated and simplified edition of the author's "Introduction to General Inorganic Chemistry" which appeared two years ago. The "Introduction" attracted much attention among teachers of chemistry, and received high praise as an excellent and comprehensive presentation of the subject, but it appears that many teachers, while admiring the book as a treatise, considered it too extensive and difficult for beginners, even at the age of college students.

It is evidently on account of these objections to the larger text-book that the shorter work under consideration has been prepared. This is shorter to the extent of more than two hundred pages, and it has been considerably simplified, chiefly by omissions of less fundamental theoretical matter. It is to be observed that the theoretical topics that have been retained have been presented with the same fullness as before, and that the aspect of the new book in its arrangement and illustrations is very similar to that of the old one, although some conspicuous changes have been made in the presentation of some of the theoretical topics, and other minor changes and improvements have been introduced.

It appears to be somewhat doubtful that the present book will appeal to the majority of those who considered the former book too difficult, because the chief changes are those of omission, and they could be made easily while using the larger book.

There is evidently a tendency at the present time to use less childish chemical text-books for older students than was formerly the custom, and this movement is undoubtedly an excellent one, as far as the education of our more capable students is concerned. Therefore, the new book, by a teacher who has shown such ability in text-book production, is to be welcomed, although it may not be considered entirely "easy," and it is to be hoped that we shall soon have a revision of his "Introduction," which, whatever may be thought of it for beginners, is a very useful book for more advanced students.

As a single criticism it may be said that several of the brief statements in regard to metallurgy need revision, even in the later edition. This metallurgical weakness is a very common fault in elementary text-books of chemistry.

H. L. Wells

Thermodynamics of Technical Gas Reactions. Seven Lectures. By Dr. F. Haber, Professor at the Technische Hochschule, Carlsruhe. Translated by Arthur B. Lamb, Ph.D., Director of the Havemeyer Chemical Laboratory, New York University. Pp. 356. London, Longmans, Green and Co. 1908.

Since Gibbs and Helmholtz showed that the

mere heat evolved is not a true measure of the driving force of a chemical reaction, chemistry has felt an ever-growing need of accurate determinations of that which is the true measure, the free energy. A knowledge of this quantity permits the theoretical chemist to predict the direction in which a reaction will proceed or the state of equilibrium to which it will arrive, and enables the technical chemist to calculate the possible yield in a given manufacture, or the amount of work obtainable from a given process.

The present volume is by far the most important contribution towards this end which has as yet been made. It is a book written to technical chemists by an acknowledged master of technical chemistry, but it will doubtless find a larger audience among the uncommercial chemists; especially in this country where a broad knowledge of thermodynamics is not yet regarded as indispensable in the training of the chemical engineer.

The first three chapters deal with the theorems of thermodynamics and the development of the general free energy equation. In the fourth and fifth chapters comes the exhaustive discussion of the conditions of equilibrium in such important reactions as the water-gas process, the Deacon process and the formation from the elements of water, carbon dioxide, ammonia and the halogen acids. The sixth chapter critically summarizes all the existing data on the specific heat of gases, which must be known if we are to calculate the free energy at one temperature from that at another. The last chapter treats in detail the experimental methods which have been employed in the study of gaseous equilibria.

After a single perusal of the book the reader may not appreciate the infinite pains, or the critical acumen amounting nearly to inspiration, with which the author has extracted the truth from a great mass of uncertain and frequently contradictory experimental material. His success in this task has been demonstrated several times since the appearance of the German edition by new experimental investigations which have fully corroborated his conclusions.

The English edition, an excellent translation, contains additional matter in the form of three appendices. The first reviews the new and sensational method proposed by Nernst for the calculation of chemical equilibrium from thermal data. The second gives in detail the results of experiments carried on in the laboratories of Nernst and the author on the free energy of formation of carbon dioxide and water, of experiments by Lewis on the electromotive force of the oxy-hydrogen cell, and of others by Lewis and Falkenstein on the Deacon process. The third appendix contains a miscellany of short notes dealing chiefly with the reaction velocity in gaseous systems.

To all who are interested in making chemistry an exact science, and who are not unwilling to read a book requiring a little thought and study, this work is heartily commended.

GILBERT N. LEWIS

Handbook of Flower Pollination. By DR. PAUL KNUTH; translated by J. R. AINSWORTH DAVIS. Vol. 2. Oxford, Clarendon Press. 1908.

For many years Hermann Müller's "Fertilization of Flowers by Insects," which had been translated into English, was the standard reference-book on all subjects connected with the relation of flowers to their insect-visitors. It was, however, getting very much out-of-date; so Dr. Paul Knuth, taking it as a basis, undertook the preparation of a new work, intended to include all the information available up to the date of publication. The new "Handbuch der Blütenbiologie" could not be included, like Müller's work, in a single volume, so it was divided into several sections. The first of these consisted of a general introduction; then came an account of the observations made in Europe; and finally, those from other parts of the world were to be given. Knuth did not live to see the last section published, but it was brought to a satisfactory completion in 1905 under the editorship of Dr. Ernst Loew.

There was naturally a demand for an English translation of the "Handbuch," and this

arduous task was undertaken by Professor J. R. Ainsworth Davis, of the University College of Wales. The first volume of the translation appeared in 1906; the second has just been published. The first volume differs from the original German, in that it contains the bibliography up to January 1, 1904. The second has been translated without substantial alterations, except that it is much more clearly printed, with fewer abbreviations. No attempt has been made to bring it up to date. The third volume, now in press, will finish the account of the European observations; and the fourth will be prepared next autumn or winter. The last part of Knuth's work, dealing with the "aussereuropäischen" observations, was naturally the most incomplete (pathetically so for many parts of the world!); and hence Professor Ainsworth Davis, in spite of the great increase of work involved, has arranged to incorporate all new information available up to the date of going to press. This will make the final volume almost a new book, and as such it will be invaluable to all students of flower pollination. American students should be careful to forward to Professor Davis any papers they may have written bearing upon the subject, and also any manuscript data they are able to furnish. Those who have the German edition will be able to note the omission of important data, and will have a chance this summer to make many observations which can be incorporated.[1]

The second volume, the immediate subject of this notice, is of great value to American workers. In the first place, most of the European plants described are of American genera, and not a few of the species are circumpolar; in the second, there are many observations on purely American forms, made in European botanical gardens. So closely, indeed, are the European and American data related, that we can not help greatly regretting that they were not combined in a single series. The separation of the European and American sections will doubtless result in many workers procuring only the one or the other, according to their place of residence. This will have the most unfortunate results; for example, American observers may work on particular genera, ignorant of the illuminating results obtained in Europe; or Europeans may take the records from botanical gardens as fairly representative for American genera, overlooking the very different data obtainable where these plants grow wild.

In the present state of the science, it is unavoidable that a work on flower pollination should contain a large amount of undigested information. The precise meaning of the long lists of visitors can not always be determined; and no doubt any author who should try to dispense with these lists, and state the results of research in general terms, would fall into many errors. There are, of course, many important and suggestive generalizations in the book; but every worker will be glad that he is supplied with the actual data at the back of these, data which he can compare minutely with those accumulated by himself.

In a work compiled from so many different sources there will necessarily be some errors. Thus the map on p. 49 does not do justice to the distribution of the humble-bees. *Bombus* extends quite to the north of Greenland (*cf.* Peary) and in Asia reaches the Philippines (*B. mearnsi* Ashmead), Sumatra (*B. senex* Snellen and *B. sumatrensis* Ckll.) and Java (*B. rufipes* Lep.).

T. D. A. Cockerell

[1] Professor Ainsworth Davis has just been appointed principal of the Royal Agricultural College, Cirencester, and should be addressed there after September 1.

SPECIAL ARTICLES

REVISION OF "THE NEW YORK SERIES."

The writer submits the following rearrangement of a part of Clarke and Schuchert's classification of the New York Paleozoic, including changes based chiefly upon the recent work of Hartnagel and others:

Hartnagel's redetermination of the Oneida conglomerate as the equivalent of the topmost or true Medina sandstone, and his separation from the latter of the great thickness of barren shales constituting his "lower Medina" with the suggestion of a disconformity at their top,

	Ulsterian.	Onondaga. Schoharie.
Eodevonic.	Oriskanian.	Esopus (Decewville). Glenerie Connelly (Port Jervis) } Oriskany. Port Ewen ("Kingston").
	Helderbergian.	Becraft. New Scotland. Kalkberg. Coeymans.
Neontaric.	Cayugan.	Manlius. Rondout. Cobleskill.
Mesontaric.	Salinan.	Bertie. Rosendale. Camillus. Wilbur. Syracuse. Binnewater. Vernon. High Falls. Pittsford. Shawangunk.
Eontaric.	Niagaran.	Guelph (Shelby). Lockport. Rochester (inc. Irondequoit). Clinton { Williamson. Wolcott (inc. Furnaceville) Sodus. Medina (Oneida).
	Cincinnatian.	Lewiston (Richmond). Lorraine (inc. Oswego). Utica.

opens a way of solution for the vexed Richmond question. These lower shales, for which he has suggested to the writer a revival of the early name LEWISTON SHALE, Hartnagel has again shown to be strictly continuous with the underlying Oswego sandstone, which in turn appears to constitute merely the closing episode of the Lorraine division. The Lewiston shales must therefore be referred to the Cincinnatian (Eopaleozoic), and that they are the true time equivalent of the Richmond beds is indicated (1) by homotaxy, (2) by the finding of the Richmond species, *Rhynchotrema capax* and *Ambonychia radiata,* high up in their supposed Pennsylvania equivalent, the "red Medina" (Juniata), as ascribed to Stevenson in Dana's Manual; (3) by the immediate succession of the Clinton to the Richmond fauna in the continuous deposits of Anticosti and (4) by the survival into the Clinton of such Richmond forms as *Platystrophia lynx* and *Calymmene senaria.* There is thus no room for the interpolation of an "Oswegan" time-division and fauna (if such existed). The Oswego and Lewiston beds as we know them are entirely barren, except for the two Richmond fossils mentioned, while the wholly minor congeries occupying the hundred feet of true Medina (Oneida) and consisting chiefly of *Lingula cuneata* and *Arthrophycus alleghaniensis* contains other forms, such as *Bucania trilobata,* which link it closely with the Clinton fauna, into which it might be merged without violence. In any case the (restricted) Medina falls within the Niagaran, which thus becomes the Eontaric, with the Clinton facies for its initial fauna in America as in Europe.

It should be noted in passing that both Hartnagel and Sarle have shown the fauna of the so-called "upper Clinton" (Irondequoit) limestone to be very nearly that of the Rochester shale, to which it should, therefore, be transferred. A rather similar development of limestone at the base of the Rochester appears to exist in Ohio. The Furnaceville ore bed lies *in* and not *below* the Wolcott limestone.

Having replaced the Niagaran in the Eontaric (compare the old Dana classification —Niagara, Salina, Lower Helderberg), it seems natural to restore the triple time-division of the Ontaric by separating the Salina series from the higher limestones of the Cayugan, to which that name may accordingly be restricted as chiefly applicable. This step is made easy by Hartnagel's unraveling of the Cobleskill limestone and discrimination of the overlying (Rondout) from the underlying (Bertie-Rosendale) "waterlimes." We now have in the marine faunas of the Cobleskill, Rondout and Manlius limestones a very natural group characterized by certain well-marked shells and corals ranging through the three formations. Quite distinct from these is the mass of barachois deposits constituting the group which may be designated by the long-established term Salinan. Hartnagel's determination of the eastern New York expression of these beds on theoretic (stratigraphic) grounds has found a gratifying confirmation through the recent discovery of a Pittsford fauna in the Shawangunk con-

glomerate, so that we are able to parallel the eastern and western series with certainty.

The Mesontaric thus becomes a unit of remarkable symmetry. It may be likened to a parabola, which, springing from the marine fauna of the Guelph dolomite, ascends through one Eurypterid fauna (the Pittsford-Shawangunk) to a culmination centrally in the barren salt beds (Syracuse) and descends through a second Eurypterid fauna (the Bertie) to a return of marine conditions with *Halysites* and other Niagaran types in the Cobleskill dolomite, itself lithologically not unlike the Guelph.

Unpublished studies by the writer on the Port Ewen fauna have shown its many affinities with that of the overlying Oriskany limestones as known at Glenerie and Becraft's Mountain. Dr. Clarke has, therefore, recommended the transfer of these beds to the Oriskanian, in spite of the preponderance of Helderbergian elements. The oft-mooted pertinence of the Esopus to the Oriskanian also appears to be affirmatively settled, at least for its lower portion, by the writer's finding of Oriskany fossils (*Leptocœlia flabellites, Chonostrophia,* etc.) forty feet above its base near Leeds, Greene Co. *Taonurus caudagalli* occurs in the Oriskany limestones at Glenerie.

In the Rondout region the last-mentioned beds, which may now be formally christened as the Glenerie limestone, are underlaid by eighteen or twenty feet of pebble-beds, typically exposed on the hill above South Rondout (Connelly post-office) and in the creek bank opposite, for which the name Connelly conglomerate is proposed. Southwestward, as at Cottekill, this latter appears to give way to shaly limestones exactly resembling those of the underlying Port Ewen, but having a strongly Oriskany fauna, and it is suspected that these are the equivalent of Barrett's *Dalmanites dentatus* zone, herein designated provisionally by the name Port Jervis.

The new name Kalkberg limestone is proposed to cover certain layers heretofore included variously by writers with the beds above or below (New Scotland and Coeymans) and carrying a mixed fauna, highly developed and excellently silicified on Catskill Creek. Here the beds show numerous thin parallel seams of black flint nodules; below these are fourteen feet of typical Coeymans, without flint, and above them are the typically shaly layers of the New Scotland. A similar association has been found at the Indian Ladder and elsewhere. The fauna is one of the most interesting and abundant in the region and combines *Sieberella galeata* with *Bilobites, Nucleospira, Delthyris, Dalmanella, Rhipidomella, Rhynchospira,* etc. The name Kalkberg (lime hill) is the local Dutch designation for the Helderbergian ridge, and is pronounced Collak-barrakh.

George H. Chadwick
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Observations upon a Yellows Disease of the Fall Dandelion

The fall dandelion, *Leontodon autumnale* Linn., is becoming one of the worst of the introduced weeds of certain sections of Maine, in meadows, along roadsides and in lawns. This is particularly the case on the lawns of the University of Maine, where the bright yellow flowers are very conspicuous from August till late autumn, in spite of frequent mowing.

Here the plant is affected with a "yellows" disease which the writer has had opportunity to observe for the past two seasons. The diseased plants are very characteristic and conspicuous because the foliage becomes much lighter colored and yellowed and tends to grow upward into a rather compact mass, especially if not cut back by the lawn mower. The plant reacts to the stimulus of the disease by producing an abnormal number of leaves and flower heads, particularly the latter. As a rule the scapes are considerably shortened and the flowers abortive, but plants only slightly affected are occasionally observed to form seeds.

These weeds were very plentiful on the lawns in the fall of 1906 and from 30 per cent. to 50 per cent. of the plants were diseased.

In 1907 there was a decided falling off in number, with respect to diseased as well as healthy plants, the proportion of the former being plainly less than in the preceding season.

On account of the obscure nature of this type of disease, its similarity to aster yellows and kindred troubles, and more particularly on account of the abundance and availability of the material a series of observations and experiments covering a number of years were planned. The outcome of one of these experiments was as follows:

In September, 1906, a number of vigorous, healthy young plants were carefully taken up and transplanted to the corner of a garden. They were placed close together, making a continuous row four or five feet long. Next plants showing early or at least not advanced stages of yellows were selected and transplanted with equal care so as to form a row on either side, parallel with, and about six or eight inches removed from, the row of diseased plants. None of the plants showed any ill effects from the transplanting. In the spring of 1907 nearly all of the diseased plants were dead and the remainder failed to survive the season. All of the healthy plants survived. They have shown no signs of yellows to date and are now strong and vigorous. A portion of the plants will now be removed from the row and placed in the rows where the diseased plants stood.

It is hoped that later work upon this disease of a more fundamental nature may be undertaken with added facilities in the shape of a greenhouse for pathological purposes and complete equipment for histological work.

W. J. MORSE
MAINE EXPERIMENT STATION

A PRINCIPLE OF ELEMENTARY LABORATORY TEACHING FOR CULTURE STUDENTS

DURING recent years, courses for culture students in the biological sciences have been widely introduced into the schools and colleges of this country. The results attained do not measure up to what was hoped for by those who placed them there. Probably no one would be more ready than the better teachers to admit that the average student, to a discouraging degree, comes short of acquiring that information or developing that power of obtaining knowledge for himself which it was planned that he should.

The difficulty is not trivial and it is not imaginary. It is one which should receive serious consideration at the hands of those whose business it is to teach. The present paper is offered as a contribution toward its solution.

One university professor of botany expressed to the writer the opinion that courses in botany are justified by the fact that some who are not adapted to other studies are awakened and develop in scientific work. The writer has known shining examples of such; their proportion, however, is small, and it seems self-evident that the teacher can be content with nothing less than to reach and to bring out the average student who comes into his classes.

The situation can best be stated by taking a concrete illustration. Suppose then, a young teacher with university training, high ideals and a certain individuality. He surrounds himself with his students, places material in their hands and asks them stimulating questions whose answers they can find out. He plans courses which include morphology, physiology and evolutionary relationship of plants. These subjects are sometimes segregated, sometimes (as their arranger thinks) ingeniously interwoven. The teaching proceeds through weeks and months. Looked at as a whole, what is the outcome? Something as follows:

The success of certain of the lessons is immediate and convincing. Perhaps, for example, those upon the morpho-physiology of seeds or upon winter buds, catch the interest of the class, incite independent effort and show every sign of living in the minds of the student. On such days the teacher tastes that fine joy which is said to be his chief reward, mingled it may be with sinful pride and a commiseration for students less fortunate than his own.

But not so much can be said of every lesson. For these the teacher frames for himself many excuses. Perhaps it was an "off day." But as the years pass by and his experience and frankness with himself increase, he is some day to realize that as a matter of fact the hours when actual independent work is being done are few and precious, and that the greater part of the laboratory time is spent in merely performing assigned tasks.

No doubt there are teachers who lift their classes above this level, but no doubt also they are few. And if such is the case, then some hard things remain to be said, viz., that for the majority of students the time given to biological courses must be justified by the information acquired, or else by the disciplinary value of doing required routine work, or else that it is not justified at all.

If conditions are as pictured, the question is pressing—"What is to be done about it?" In looking for a solution my point of departure would be the fact that *certain* of the lessons actually do call out a real interested and independent effort on the part of the student. That ounce of fact is worth tons of theorizing. Then if it is true that the greatest good which can come to the student out of such courses is the development of his own powers of obtaining knowledge, it would not seem far to this principle. *The laboratory course should be composed mainly of those lessons which the instructor can so present as to arouse independent effort on the part of the student.*

Then the question will at once arise "what about the lessons of which this is not true; what about the many and important topics in which the student can at best scarcely do more than to perform faithfully the task assigned?" My answer would be to remove most of them frankly to the domain of lecture and demonstration. A good demonstration, where the student feels the spark of inspiration from the teacher's performance and example, is far better for both teacher and student than a time-serving laboratory exercise. In our haste to emphasize the laboratory method we have swung too far the other way and made too little of what must ever be one of the prime factors of good teaching—the inspiring example of the teacher.

No doubt a certain proportion of laboratory lessons which are mere verification exercises are desirable, but on the whole it still remains true that for culture students *the laboratory hours are too precious to be used in anything but independence begetting work.* In the lecture room is the place to see that the course is rounded out, kept coherent and the ground covered.

It may be permissible to add here a point which in the writer's experience has been worked out as a sort of corollary to the above principle. In blindly attempting to keep the students interested and working on their own initiative, I have found the laboratory work to grow more and more physiological in character.

In studying life histories, for example, I have found my classes to maintain a rather high degree of interest from the algæ up to about the ferns, and then the interest to wane as the homologies with the seed plants are taken up. After some time I perceived that that which held their interest was in the processes rather than in the organs of reproduction; that though they learned something about the homologies of endosperm, prothallus, etc., they did so under some pressure and forgot it with alacrity; and that in their hearts they did not care whether it was so or not. Slowly and with regret I came to the conclusion that in my classes at any rate the "deeper morphology" could not compete with other topics for a place in an elementary course.

Far otherwise was it with subjects which at first I had not had the students really work at all—respiration, photosynthesis, irritability. Here the interest and willingness to work was instantaneous and sustained. When it is considered furthermore that the teacher can give more just and stimulating criticism of the setting up of an experiment than he can of the performance of a dissection; that that which is permanently remembered by the student is after all very little,

and that ideas of the life activities of plants are among the most valuable in the subject-matter of botany, the case seems fairly complete for a course dominated by physiology.

In mentioning this seeming corollary I would not have it confounded with the principle which is here advanced. The principle should hold at all events. If a given teacher finds his classes to be most interested and to work hardest in morphology, then morphological problems should claim the laboratory time. The principle is to make any needful sacrifice in order to achieve the main object, to keep the student at his maximum of interest and independent effort.

CHARLES H. SHAW

SOCIETIES AND ACADEMIES

THE NEW YORK ACADEMY OF SCIENCES, SECTION OF GEOLOGY AND MINERALOGY

AT the regular monthly meeting of February 3, 1908, the following program was presented:

On Determination of Mineral Constitution through Recasting of Analyses: ALEXIS A. JULIEN.

The results of investigations continued along the line of complex mineral micro-aggregates, brought before the academy at the January meeting, were shown in a series of charts. It appears certain in the case of very complex mineral analyses, after giving due weight to the physical characters and origin of the substances, together with the readiness with which these analyses yield to the process of recasting, that many so-called mineral species are in reality very complex micro-aggregates. One illustration, taken from the complete paper, which is to be issued in the *Annals* of the New York Academy of Sciences, Vol. XVIII., Part II., No. 3, is here given as a suggestive case.

Diabantite, from Farmington Hills, Conn.: Mean of two analyses by G. W. HAWES.

		Per Cent
Silica	SiO_2	33.46
Alumina	Al_2O_3	10.96
Ferric oxide	Fe_2O_3	2.56
Ferrous oxide	FeO	24.72
Manganous oxide	MnO	.39
Lime	CaO	.92
Magnesia	MgO	16.52
Soda	Na_2O	.29
Water	H_2O	9.96
Total		99.78

This is said, by the analyst, to be "a unisilicate of the pyrosclerite group, with the formula,

$$(\tfrac{2}{3}\dot{R}_2 + \tfrac{1}{3}\dddot{Al})\ddot{Si}_3 + 3\dot{H}."$$

Dana states that the figures "correspond to the formula $R_{12}(R_2)_2Si_9O_{36} + 9aq$, which is near to that of pyrosclerite," and also

"*Comp.* $H_{18}(FeMg)_{12}Al_4Si_9O_{45}$, or

$12(FeMg)O\ 2Al_2O_3\ 9SiO_2\ 9H_2O$."

In the recalculation Dr. Julien assumes for the residual pyroxene the same composition as was determined by Hawes for that mineral from an outcrop of diabase in the same region. On this basis the following hypothetical constituents are indicated:

	Per Cent.
Pyroxene (residual)	6.78
Enstatite (residual)	10.45
Prochlorite	54.45
Ekmanite	16.33
Deweylite	8.42
Limonite	2.99
Periclase (magnesia)	0.36

It is apparent by making further comparison that diabantite is not identical with diabantachronyn, and it is not at all likely that any specimens of either mixture are ever identical.

The Annual Meeting of the Geological Society of America, Albuquerque, N. M., December 30–31, 1907: E. O. HOVEY.

An account of the chief points of interest in connection with the meeting was given.

A Revised Cross-section of the Rondout Valley along the Line of the Catskill Aqueduct: CHARLES P. BERKEY.

Explorations of the Board of Water Supply of New York City are now almost completed across the Rondout Valley. There are twelve distinct formations of stratified rock involved, all of which will be cut by the projected pressure tunnel. One unconformity in the series separates the Ordovician Hudson River slates from the overlying conglomerates, shales, sandstones and limestones of Silurian and Devonian age. There are three faults of considerable displacement, together with smaller ones and minor foldings. In the effort to determine the variations of these formations as to thickness, depth from surface, displacements, physical conditions, water content and capacity, the presence of caves or relative solubility, and the position and depth of the buried channels beneath the drift cover, the available figures are

so abundant that the cross-section may be considered accurate within a few feet for a considerable proportion of the whole width of the valley, a distance of four miles, and to a depth of 300 to 500 feet. Several drawings illustrating these features in detail, originally prepared for the chief engineer of the Board of Water Supply, were shown by permission, and the successive stages in interpretation of results were pointed out.

Present Trend of Investigation on Underground Waters: James F. Kemp.

Within a few years there has been a marked change of views upon the sources, distribution and extent of underground waters. As recently as 1900, in one of the most important discussions, they were believed to be practically continuous from the groundwater level to the depth of possible cavities and to be almost, if not quite, solely of meteoric origin. Whereas now a very large number of geologists have come to regard the underground water as limited to a comparatively shallow zone; to refer uprising heated waters from deeper zones to magmatic sources in cooling and consolidating bodies of igneous rock; and to attribute some part of the underground waters to the same place of origin. In the interpretation of ore-bodies magmatic waters have been found to be much more reasonable agents of deposition, in many cases, than are the meteoric.

In 1901, on the basis of experience in mines, Professor Kemp made the argument that the groundwater only extended to depths of 1,000 to 2,000 feet. Recently this has had strong corroboration in a paper by M. L. Fuller, of the U. S. Geological Survey (Water Supply and Irrigation Papers, No. 160, pp. 61, 62, 72). Delesse, in 1861, estimated the groundwater as equal to a layer over the globe 7,500 feet deep; Schlichter, in 1902, as equal to one 3,000 to 3,500 feet; Van Hise, in 1904, 226 feet; Chamberlin and Salisbury, in 1904, 800 to 1,600 feet; Fuller, with the completest data of all, to one of only 96 feet. If we assign to the rocks an average of 5 per cent. of cavities, 96 feet of water would just about extend to 2,000 feet, and if 10 per cent. of voids, to 1,000 feet depths, strongly corroborative of the original argument and per cents. used in previous discussions.

From this we are forced to conclude that meteoric sources and underground amounts have been much overestimated.

Chas. P. Berkey,
Secretary of Section

THE TEXAS ACADEMY OF SCIENCE

At the regular meeting of the Texas Academy of Science, held in the Engineering Building of the University of Texas, February 21, 1908, Miss May Jarvis, B.A., tutor in zoology in the university, presented a paper on "Lord Monboddo, a Precursor of the Darwins"; Professor T. U. Taylor, dean of the department of engineering, followed with "Notes on City Surveying," and Dr. William T. Mather, professor of physics, gave a brief sketch of the life and work of Lord Kelvin.

On Friday, March 13, Dr. J. W. McLaughlin, of Austin, a regent of the university and former member of the medical faculty, read a carefully prepared paper entitled "A New Theory of Ferments" which, with the discussion that followed, occupied the entire session.

At the meeting of the academy held April 11, Dr. G. S. Fraps, state chemist, College Station, Texas, discussed "Soil Fertility and Phosphoric Acid."

The program of the meeting for May 8 included "The Law of Fall of Rivers and the Value of the Deduced Curve in River Improvements," by Mr. F. Oppikoffer, U. S. Engineer, Department of Texas, Tarpon, Texas, and a lecture "On Apoidal Stars," by Dr. H. Y. Benedict, professor of applied mathematics in the university.

At the formal meeting, held June 8, papers entitled "Some Figures on the Cost of Freight and Passenger Train Service," by Mr. R. A. Thompson, expert engineer for the Railroad Commission of Texas, and "Fossil Tracks in the Del Rio Clay," by Professor J. A. Udden, of Rock Island, Illinois, were read by title. The ballots having been duly counted the following officers for the year 1908–9 were declared elected:

President—Dr. Eugene P. Schoch, University of Texas, Austin.

Vice-President—Dr. G. S. Fraps, A. and M. College of Texas, College Station.

Treasurer—Mr. R. A. Thompson, C.E., Austin.

Secretary—Dr. Frederic W. Simonds, University of Texas, Austin.

Librarian—Mr. P. L. Windsor, librarian of the university, Austin.

Members of the Council—Hon. A. E. Wilkinson, Austin; Dr. Homer Hill, Austin; Professor O. C. Charlton, Bryan, Texas.

Frederic W. Simonds,
Secretary

Austin, Texas,
July 15, 1908